

Phelsuma

Volume 1



Contents

| | |
|---|----|
| Editorial - Introduction to <i>Phelsuma</i> | 1 |
| Chairman's report | 2 |
| 1992 Report on Roche Caiman Bird Sanctuary | 4 |
| Mapping projects | 15 |
| Summary of publications | 17 |
| The conservation of Silhouette island, Seychelles. I. Plants <i>J. Gerlach</i> | 18 |
| The conservation of Silhouette island, Seychelles. II. Animals <i>J. Gerlach</i> | 30 |

Editorial

Introduction to *Phelsuma*

Phelsuma, the annual journal of the Nature Protection Trust of Seychelles, has been founded with two primary aims. The first is to report on the trust's activities and the second to provide a platform for reports on, and discussions of, the nature of the western Indian Ocean area. Towards these aims it is intended that the journal will publish scientific papers, discussion articles and notes on the biology and geology of the region. Being the journal of the NPTS most reports will concern the Seychelles islands but coverage of the entire western Indian Ocean region is envisaged. The choice of title reflects the intended coverage; the *Phelsuma* day geckoes being a primarily western Indian Ocean genus, with outlying species in the Andamans to the east and Namibia to the west. The complex speciation patterns of the genus and high levels of endemism make them a suitable title choice for a journal aiming to report on this highly significant region of insular biodiversity.

The Nature Protection Trust of Seychelles is a non-governmental organisation dedicated to the preservation of the ecosystems and flora and fauna of the Seychelles islands (the Trust's background is covered in the chairman's report) this means that many of the reports in *Phelsuma* will be largely concerned with conservation, however, it is intended that the journal will publish papers on all aspects of nature, including conservation, biogeography, ecology, animal behaviour, evolution, systematics and geology. This first issue carries papers on the status of the flora and fauna of the island of Silhouette in Seychelles, highlighting the great conservation value of the island. Plans for the second (1994) issue include papers on the ecology of the carnivorous snail *Euglandina rosea* in Seychelles and the Mascarenes, a discussion of the origins of introduced plant species and species diversity - island area relationships in the western Indian Ocean.

In addition to original research papers and discussions the journal also carries regular reports on ongoing projects carried out by the NPTS, which in this issue include management of the Roche Caiman Bird Sanctuary on Mahé and vegetation mapping projects. An important feature of the journal is the section carrying summaries of publications concerning Seychelles published in the previous year. these summarises are probably not complete as they only represent those publications brought to the editor's attention before the date of publication of *Phelsuma*. The service this feature provides would be enhanced if authors with publications concerning the region would bring them to the attention of the editor. Similarly all contributions (in the forms of papers, discussion articles or notes) should be sent to the editor, using previous issues of the journal as a guide to format. Illustrations are requested to be in the form of clear line drawings or full size black and white prints.

Chairman's report

The Nature Protection Trust of Seychelles was registered on 8th June 1992 at a time of change in the political history of the islands. For the first time in many years decisions taken on the environment by the government could be questioned. A successful campaign to save the east coast tidal and freshwater marsh so important to migratory shorebirds resulted in the coming together of a number of people with similar concerns. From this small nucleus the Trust was formed. At the outset it was agreed that membership should be open to those long-term residents who have a stake in the future of the islands or those temporary members who were willing to volunteer their time and labour. The main criterion for membership is the belief that nature should not be exploited for man's pleasure.

Most of the efforts of the Trust in 1992 were concentrated on the Roche Caiman Bird Sanctuary. We started by cleaning the sanctuary as soon as it had been given official status and we had some idea of the boundaries. Sunday afternoon work parties also removed traces of bulldozer tracks, planted reeds, cut and transplanted mangroves, dug a scrape, built an island above flood level, hand-filled an area along the north fence where the fill was too low and planted more than 100 *Scaevola sericea* cuttings along this exposed north boundary.

Our main sponsor during 1992 was the U.S. Embassy who donated the full cost of importing and erecting the fence. This project went without a hitch and was completed well within the six month time limit. Mahé Shipping cleared the materials and transported them to the site free of charge. We received donations from Aire Liquide Seychelles for printing of the "Shorebirds" poster which was our first fund-raising venture. Edwin Palmer helped with a short-term loan to finance the printing of our Christmas card. Our only personal donation came from the late Mrs Dorothy Michel whose support will be sadly missed. We are grateful to these sponsors for their much valued support.

List of sponsors in 1992: U.S. Embassy
Aire Liquide Seychelles
Mahé Shipping
Ministry of Finance
Mrs Dorothy Michel
Eku Beer (Seybrew Ltd.)

Environmental education

The campaign to save the Roche Caiman Bird Sanctuary started as a news media campaign which gave us a weekly slot in the "Nation". We have contributed regular articles about birds and news of the bird sanctuary with the intention not only of saving the sanctuary but educating the public about one aspect of our environment.

A series for young people was produced for "Regar". This series called 'Nature Watch' covered subjects ranging from weather, soil, insects, amphibians and reptiles. This series has now been superseded by a do-it-yourself bird book which deals with one species per

week.

The "Shorebirds" poster was intended for use by the schools and in particular by the hotel school where tour guides are trained. We also hoped that the conservation department would find them useful for their rangers. Unfortunately we have had no support for this project but have sold most posters to tourists.

Birdwatch

We started the Birdwatch group back in 1991 during the early stages of the bird sanctuary campaign. It was hoped that young Seychellois would join and they would form the core from which future wardens and ornithologists would develop. Possibly because nature is so much part of their everyday lives the young people are not attracted to natural history. We are not too despondent about this lack of interest because we have been trying to attract members who join because they want to, not because of coercion. So far we have two Seychellois members.

A quarterly newsletter is now in its second year of publication. *Birdwatch* is sponsored by Seybrew who computerise and print each issue. The newsletter contains regular news of birds of interest seen on the islands; bird sanctuary news; news from Fregate Island and Bird Island and a section devoted to the Seychelles Bird Records Committee.

Chairman

1992 Report on Roche Caiman Bird Sanctuary

The establishment and management of the Roche Caiman Bird Sanctuary was the first project undertaken by the NPTS. The history of the site is summarised below from a report published in *Oryx*, the journal of the Fauna and Flora Preservation Society, in 1992 (Gerlach 1992).

In 1986 4km of coral reef were dredged on the east coast of Mahé, Seychelles and used to create a large area of land. While this reclamation destroyed a considerable area of living coral it inadvertently created an area of habitat that is rare in Seychelles. The settlement pond used during dredging remained as a depression in the coral rubble and during the rains of December 1986-February 1987 it partially filled with water. This coincided with the presence of migratory shorebirds in the region and the open area of shallow water attracted unexpectedly large numbers of birds.

In 1991 the East Coast Development Project was extended further. the area of land was expanded and coral was stockpiled for future use, making it necessary to move a rubbish tip. It was proposed that the rubbish be moved into the bird sanctuary and covered with coral, supporting this by stating that migratory birds no longer used the site and that the water was polluted. R. Gerlach pointed out that the lack of birds at the time was due to their being at



Figure 1 Bird sanctuary 10/1/93 (photo: J. Gerlach)

their summer breeding grounds. Then the following week the first migratory birds of the season arrived. Radio Television Seychelles covered the arrival of the birds and also countered the pollution claim by demonstrating that aquatic life was still present in the pool. As a result of these protests, the decision to fill in the wetland was reversed and the reserve was reinstated on the development plans, although the area allocated is now only 29,000m² (the original sedimentation depression was 75,000m²). The sanctuary appeared in the government gazette on the 15th June 1992, the date of its official recognition.

The sanctuary is managed with the aims of maintaining the site's suitability for migrant wading birds and maximising its diversity. Natural processes of succession that could lead to a decrease in diversity or deterioration of specific features can be controlled by active intervention justifiably as the area is entirely man-made. In addition to this artificiality the small size of the sanctuary means that active management is essential to prevent habitat deterioration. The management plan has been drawn up based on surveys of the flora and fauna. The surveys initiated in 1992 will be continue on a permanent basis to provide information on colonisation and succession and to monitor change. It is to be hoped that full species lists can be compiled, at present monitoring work concentrates on recording numbers and species of plants, invertebrates, fish, amphibians, reptiles and birds. The monitoring programmes are described below and management procedures resulting from survey data are outlined.

1). Vegetation surveys

The date of first observation of any plant species within the sanctuary fence is noted. At present several species remain unidentified, most of these are excluded from the list below and will be reported on once identification is confirmed. The dates recorded are dates of first observation, not necessarily first occurrence.

| | Planted | | Colonised | |
|------------------------------------|---------|------|-----------|-------|
| | <1992 | 1/93 | <7/92 | <1/93 |
| Pteridophyta | | | | |
| <i>Acrostichum aureum</i> | . | . | + | . |
| <i>Nephrolepis biserrata</i> | . | . | + | . |
| <i>Sphaerostephanos unita</i> | . | . | + | . |
| Pitosporeae | | | | |
| <i>Pitosporum wrightii</i> | . | + | . | . |
| Guttiferac | | | | |
| <i>Calophyllum inophyllum</i> | ? | . | ? | . |
| Malvaceae | | | | |
| <i>Hibiscus tiliaceus</i> | . | + | . | . |
| <i>Thespesia populnea</i> | + | . | . | . |
| Meliaceae | | | | |
| <i>Xylocarpus granatum</i> | . | + | . | . |
| Leguminosae | | | | |
| <i>Cassia occidentalis</i> | . | . | . | + |
| <i>Leucaena leucocephala</i> | . | . | . | + |
| <i>Pithecellobium unguis-catti</i> | . | . | . | + |
| <i>Cannavalia cathartica</i> | . | . | . | + |
| <i>Erythrina variegata</i> | . | + | . | . |
| Rhizophoraceae | | | | |
| <i>Rhizophora mucronata</i> | + | . | . | . |

| | Planted | | Colonized | |
|-----------------------------------|---------|------|-----------|-------|
| | <1992 | 1/93 | <1992 | <1/93 |
| Combretaceae | | | | |
| <i>Terminalia catappa</i> | + | . | . | . |
| Passifloraceae | | | | |
| <i>Passiflora foetida</i> | . | . | + | . |
| <i>P. suberosa</i> | . | . | . | + |
| Caricaceae | | | | |
| <i>Carica papaya</i> | . | . | + | . |
| Goodeniaceae | | | | |
| <i>Scaevola sericea</i> | . | + | . | . |
| Apocynaceae | | | | |
| <i>Alstonia macrophylla</i> | . | . | + | . |
| Boraginaceae | | | | |
| <i>Cordia subcordata</i> | + | . | . | . |
| Convolvulaceae | | | | |
| <i>Ipomoea obscura</i> | . | . | . | + |
| <i>I. pes-caprae</i> | . | . | + | . |
| Solanaceae | | | | |
| <i>Solanum nigrum</i> | . | . | . | + |
| Bignoniaceae | | | | |
| <i>Tabebuia pallida</i> | . | . | + | . |
| Verbenaceae | | | | |
| <i>Lantana camara</i> | . | . | + | . |
| <i>Lippia nodiflora</i> | . | . | + | . |
| <i>Premna obtusifolia</i> | . | . | + | . |
| <i>Stachytarpheta urticifolia</i> | . | . | . | + |
| Avicenniaceae | | | | |
| <i>Avicennia marina</i> | + | . | . | . |
| Lauraceae | | | | |
| <i>Cinnamomum verum</i> | . | . | + | . |
| Hernandiaceae | | | | |
| <i>Hernandia nymphaeifolia</i> | . | + | . | . |
| Euphorbiaceae | | | | |
| <i>Euphorbia hirta</i> | . | . | . | + |
| Moraceae | | | | |
| <i>Ficus avi-avi</i> | . | . | . | + |
| <i>F. nautarum</i> | . | . | + | . |
| Casuarinaceae | | | | |
| <i>Casuarina equisetifolia</i> | + | . | . | . |
| Typhaceae | | | | |
| <i>Typha javanica</i> | . | . | + | . |
| Cyperaceae | | | | |
| <i>Cyperus rotundus</i> | . | . | + | . |
| <i>Dactyloctenium aegyptium</i> | . | . | . | + |
| <i>Fimbristylis complanata</i> | . | . | + | . |
| <i>F. cymosa</i> | . | . | . | + |
| <i>F. spathacea</i> | . | . | . | + |
| Gramineae | | | | |
| <i>Aristida setacea</i> | . | . | . | + |
| <i>Brachiaria brizantha</i> | . | . | + | . |
| <i>Pennisetum polystachion</i> | . | . | . | + |
| <i>Rhynchelytrum repens</i> | . | . | . | + |
| <i>Stenotaphrum dimidiatum</i> | . | . | . | + |

Quantitative vegetation monitoring started in July 1992 using a system of regularly spaced 1m^2 quadrats. The initial survey was undertaken to provide an outline map of the sanctuary allowing management areas to be designated. This overall survey took the form of dividing the sanctuary into $10 \times 10\text{m}$ blocks, each labelled with numerical and alphabetical coordinates starting from the south-west corner (Fig. 2.). A 1m^2 quadrat was positioned in the south-west corner of each block. In these percent cover formed by each species was recorded as were the presence of standing water and percentage of bare ground. The depth of leaf litter and vegetation height (both in cm) were estimated from the centre of the quadrat. The latter was provided by measuring the maximum height of vegetation touching a vertical marker.

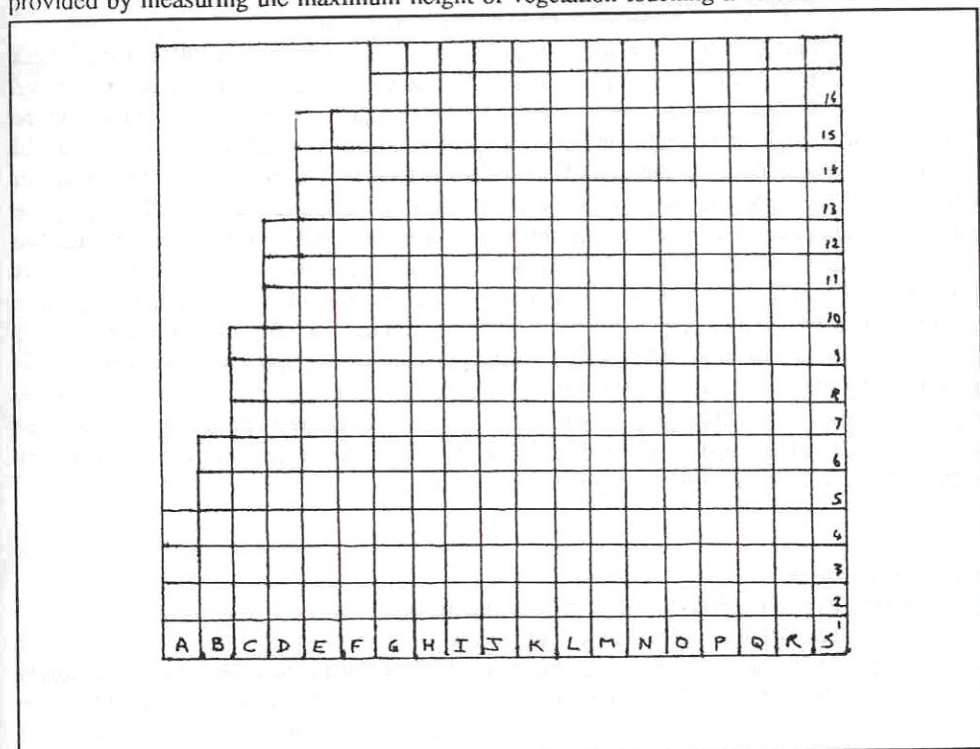


Figure 2 Quadrat grid

13 plant species were recorded in the quadrats. 7 habitat types were identified with the following characteristics:

- 1). Water - open water covering >60% of the area.
- 2). Open ground - less than 40% plant cover.
- 3). Trees - tree cover present.
- 4). Reeds - >40% *Typha javanica* cover.
- 5). Sedge - >40% Cyperaceae cover.
- 6). Ferns - >25% fern cover.
- 7). Mangroves - open ground with mangroves present.

Continued monitoring will determine how successional processes change these habitat types. Permanent monitoring of the entire sanctuary is not practical at present, the following quadrats will be surveyed twice a year to provide information on vegetation changes:

A3,B4,C5,C6,C9,D4,D8,D11,E3,E6,E11,E14,F13,F15,G10,G13,G14,H14,
I12,J16,K13,M7,N10,O9,P8,P10,Q5,Q8,Q11,Q14,Q15,R3,R5,R7,R13,S1,
S4,S8,S9,S11

These represent 5 quadrats in the open, reeds, sedge, fern, dense and open mangroves and 10 in the trees. These numbers are too small to allow extensive statistical analysis of the data but should serve the management purposes of identifying major changes and patterns.

In addition to monitoring and maintaining these habitat zones vegetation management seeks to increase floral diversity by planting selected indigenous trees and removing introduced species liable to dominate the area. Many of the introduced species recorded would be impossible to eradicate completely and eradication would be inappropriate as recolonisation is inevitable. Where possible the abundance of such species will be reduced by cutting or uprooting. The more invasive species will be removed (*Lantana camara*, *Pithecellobium unguis-cati* and *Leucaena leucocephala*) this will have to be repeated on a permanent basis but their control is essential. Although *Casuarina equisetifolia* may be a native species it covers a disproportionately large part of the sanctuary, the dense shade cast and the deep litter produced tend to smother other species and prevent colonisation. *C. equisetifolia* may have adverse effects on terrestrial and aquatic invertebrate faunas as the species is known to contain molluscicidal terpenes (Kloos & McCullough 1987). In order to increase floral diversity the *C. equisetifolia* areas will be gradually reduced by selective removal and underplanting. The extensive areas of mangroves planted regimentally are in the process of being removed or relocated to produce a more appropriate distribution.

2). Invertebrates

Five methods of invertebrate monitoring are used:

- 1). Leaf litter samples see below
- 2). Sweep netting specific areas of each habitat type to be surveyed regularly
- 3). Flight interception one flight interceptor trap to be erected in a fixed location for regular sampling of aerial insects
- 4). Tree trunk sampling brushing of a specified area of bark of different tree species
- 5). Spot counts recording numbers of Crustacea and Odonata seen in a specific time period from a fixed point

Data for reporting are only available from leaf litter sampling at present. Litter was sampled according to a protocol previously used in invertebrate surveys in Seychelles (Oxford University Silhouette Expedition 1990, and unpublished studies) to allow comparisons with other habitats. The method used is to collect an area of leaf litter (usually 1m² but varying depending on litter depth and composition) down to the surface of the soil. This is sieved and placed in a Winkler apparatus. All invertebrates collected by this stage are recorded as are those that pass through the Winkler over a period of 3-4 days. At the sanctuary a pilot sample was taken in January 1993. This consisted of 1m² of *Casuarina equisetifolia* litter in 5 sub-samples. The limited area sampled and a paucity of comparative data at this stage mean that

comparisons between sites must be made cautiously. As these ongoing studies progress a more reliable volume of data will be generated. Currently available data are summarised below:

| Taxon | Bird Sanct. | Congo Rouge | Copolia | La Reserve | Le Nioi | Trois Freres | Pisonia forest (Silhouette) |
|-------------------------------|-------------|-------------|---------|------------|---------|--------------|-----------------------------|
| Sample area (m ²) | 1 | 1 | 3 | 1.5 | 2 | 4 | 60 |
| Mollusca | 12 | 10 | 3.3 | 2 | 11.5 | 7.25 | 5.78 |
| Nemertea | - | - | - | - | 1 | 0.75 | 0.02 |
| Oligochaeta | 1 | - | - | - | - | - | - |
| Hirudinea | - | - | - | - | - | - | 0.15 |
| Amphipoda | - | 1 | - | - | 10.5 | - | - |
| Isopoda | 251 | - | 0.67 | 2 | - | - | 5.87 |
| Chilopoda | - | - | - | 4 | 6.5 | 0.75 | 1.2 |
| Diplopoda | - | 7 | 0.67 | 2 | 1 | - | 5.36 |
| Symphyla | 35 | - | - | 2 | 0.5 | - | - |
| Opiliones | - | 1 | 6 | 2 | - | - | 0.47 |
| Arachnida | 22 | - | 5.3 | 8 | 2 | 9.25 | 1.3 |
| Pseudoscorpiones | - | - | - | - | - | 1 | - |
| Schizomida | - | - | 1.67 | 1 | 3.5 | 1 | 0.04 |
| Diptera | - | 2 | 4.3 | 2 | 1 | - | 15.75 |
| Dictyoptera | 4 | - | - | 5 | 3.5 | 5 | 0.02 |
| Orthoptera | - | 1 | - | - | - | - | 0.08 |
| Psocoptera | 4 | - | - | - | 0.5 | 3 | 0.03 |
| Lepidoptera | - | - | - | 8 | - | 2 | 7.8 |
| Hemiptera | - | - | 0.3 | - | - | - | 3.98 |
| Hymenoptera | 13 | 6 | 0.67 | 19 | 47 | 38 | 33.72 |
| Dermaptera | 8 | - | - | - | 16.5 | - | 12.75 |
| Coleoptera | 19 | 11 | 4.7 | 1 | 6 | 3.25 | 37.17 |
| Mallophaga | 2 | - | - | - | - | - | - |

It is of interest to note the great preponderance of isopods and symphylans in the sanctuary litter compared to all other sites. The two mallophagan bird lice are also unusual in litter samples, these are probably a result of the large numbers of birds in the sanctuary. Without more samples and information on the origin of the taxa concerned no reliable conclusions can be drawn. At present only *Casuarina equisetifolia* litter is available for sampling in the sanctuary, as tree diversity increases a greater variety of types will be available. This sampling will be repeated on a permanent basis at least once a year.

Details of the methodologies used in the other invertebrate surveys will be given in subsequent reports.

In addition to quantitative surveys species lists are being compiled for all groups. Identified taxa include

Mollusca: *Achatina fulica**, *Lamellaxis javanicum**, *L. gracilis**, *Opeas pumilum**, *Quickia concisa**, *Melanoides tuberculata*, *Terebralia palustris**

(* = permanent breeding populations)

3). Vertebrates

All 5 classes of vertebrates have been recorded in the sanctuary. Of these the mammals are represented by dogs (*Canis domesticus*) only (it is presumed that rats, *Rattus rattus*, do occur but these have not been observed to date). Up to 6 stray dogs were regularly observed in the sanctuary prior to the completion of the boundary fence. All dogs were excluded from the fenced area by 2/1/93. The other classes are reported on in more detail below:

3a). Fish

Fish are present in the sanctuary whenever there is water. A permanent population resides in the pools along the southern boundary but as soon as the water level rises and spreads across the central area fish are present there. The deep brackish pools in the south are connected to the sea by an outflow channel. During the northwest monsoon (January-March) the water from the sanctuary flows into the sea. Very high tides (1.9-2.1m) reverse the flow during drier periods and feed sea water into the deep pools.

Species recorded are listed below:

Tilapia - *Oreochromis mossambicus*

Occur in all areas of water, first record 26/7/92 (seen but not identified since 1988). Permanent breeding population.

Round herring - *Eutremus teres*

First recorded on 15/11/92 in water collected from a depression on the north boundary. This depression was created during the dry season and filled with rain water. At no time was this connected to any other water and dried out by 29/11/92. The recently hatched fry were presumably introduced to the pool on the feet of a bird as eggs as they numbered between 50-100. The only bird seen at this pool was a common sandpiper (*Actitis hypoleucos*) but other birds could also have visited the pool.

Mudskippers - *Periophthalmus sobrinus*

Seen on edge of the deep pools on 22/11/92.

Sâp-sap - *Monodactylus argentea*

First recorded in the pool in quadrat B5 on 26/7/92.

Goby? - Gobiidae sp?

An unidentified species, possibly a goby, was first recorded on 26/7/92 in the shallow pond in quadrat B5. This subsequently dried out.

3b). Amphibians

The introduced Mascarene frog (*Ptychadena mascariensis*) has been recorded in the sanctuary. No quantitative estimate of density has been made, two transect lines have been defined to provide a means of collecting data on temporal variation in abundance. Abundance is estimated by walking along each transect once, all frogs observed 1m either side of the line are recorded. This survey method is repeated frequently but not at fixed dates.

3c). Reptiles

The Seychelles skink (*Mabuya sechellensis*) has been observed in all vegetated areas of the sanctuary. Surveys of this species are carried out as above for amphibia.

3d). Birds

Bird records have been kept since 25/12/88. Regular detailed records date from 13/9/91, the date on which the campaign to retain the area as a bird sanctuary was initiated. These counts were published in the weekly Birdwatch column in the Nation newspaper in Seychelles. Summarised bird lists are given below:

[illegible]

| | Numbers in 1991 | | | | | Numbers in 1992 | | | | | | | | | | |
|------------------------|-----------------|----|----|----|---|-----------------|----|---|----|-----|----|----|----|----|----|----|
| | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D |
| | | | | | | | | | | | | | | | | |
| moorhen | - | - | - | - | 2 | 5 | - | - | 2 | - | - | - | - | - | - | + |
| green-backed heron | 1 | + | 1 | + | 1 | 2 | + | + | 1 | 2 | + | + | + | 3 | + | + |
| grey heron | 1 | - | 5 | 2 | 4 | 8 | 12 | - | 7 | 6 | - | 6 | 7 | 13 | + | + |
| purple heron | - | - | - | - | - | - | - | ? | - | - | - | - | - | - | - | - |
| little egret | - | - | - | - | - | 2 | 2 | - | - | - | - | - | - | 1 | 1 | 1 |
| cattle egret | 300 | + | + | + | + | + | + | + | - | - | - | - | - | + | - | + |
| curlew | - | 1 | 2 | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| whimbrel | 23 | 8 | 7 | 6 | + | + | + | + | - | 9 | + | 7 | 9 | + | 1 | 2 |
| bar-tailed godwit | 4 | 2 | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - |
| greenshank | 6 | 6 | 17 | 5 | 2 | + | + | + | 3 | 8 | 1 | + | 6 | 7 | 13 | + |
| marsh sandpiper | 3 | 4 | - | - | - | - | - | ? | - | - | - | - | - | - | - | - |
| Terek sandpiper | 12 | 7 | 2 | 2 | - | + | - | + | - | - | 1 | 1 | - | - | - | - |
| curlew sandpiper | 81 | 45 | 30 | 30 | - | + | + | + | 20 | 120 | 38 | - | 37 | + | - | + |
| greater sandplover | 10 | 5 | 1 | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| lesser sandplover | 4 | 14 | 5 | 3 | - | - | - | - | - | - | 2 | 12 | - | - | - | - |
| grey plover | 49 | 30 | 6 | 9 | - | - | - | - | 10 | 24 | 2 | + | 12 | + | - | 17 |
| Pacific golden plover | - | - | 2 | 1 | - | + | - | - | - | - | - | - | - | - | - | - |
| sharp-tailed sandpiper | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |

In addition to the above species one ruddy shelduck was recorded on 25/12/88. Permanent residents in the sanctuary are the Indian mynah, barred ground dove, Madagascar fody and Seychelles sunbird. Of these the barred ground dove and fody have been recorded as breeding.

References:

Gerlach J. 1992

A sanctuary for migrant waders in Seychelles. *Oryx* 26(3); 129.

Kloos H. & McCullough F.S. 1987

Plants with Recognised Molluscicidal Activity, in *Plant Molluscicides*, Mott K.E. (ed.), Wiley & Sons, Chichester.

Oxford University Silhouette Expedition 1990

Final report.

Mapping projects

As part of planned ecosystem monitoring programmes the distribution of rare endemic plant species is being mapped. It is intended that the grid system used will allow annual monitoring of distribution and status of plant populations. Furthermore the system should allow the compilation of a data-base on habitat structure and local biodiversity, with cross-species comparisons providing information on ecological interactions and seasonal changes in abundance and distribution. Ultimately the information provided should allow prediction of ecological changes for use in defining and implementing management programmes.

The grid consists of 500x500m squares overlaid onto the survey maps. The location of populations of two plant species have been mapped onto this grid on Mahé and Silhouette.

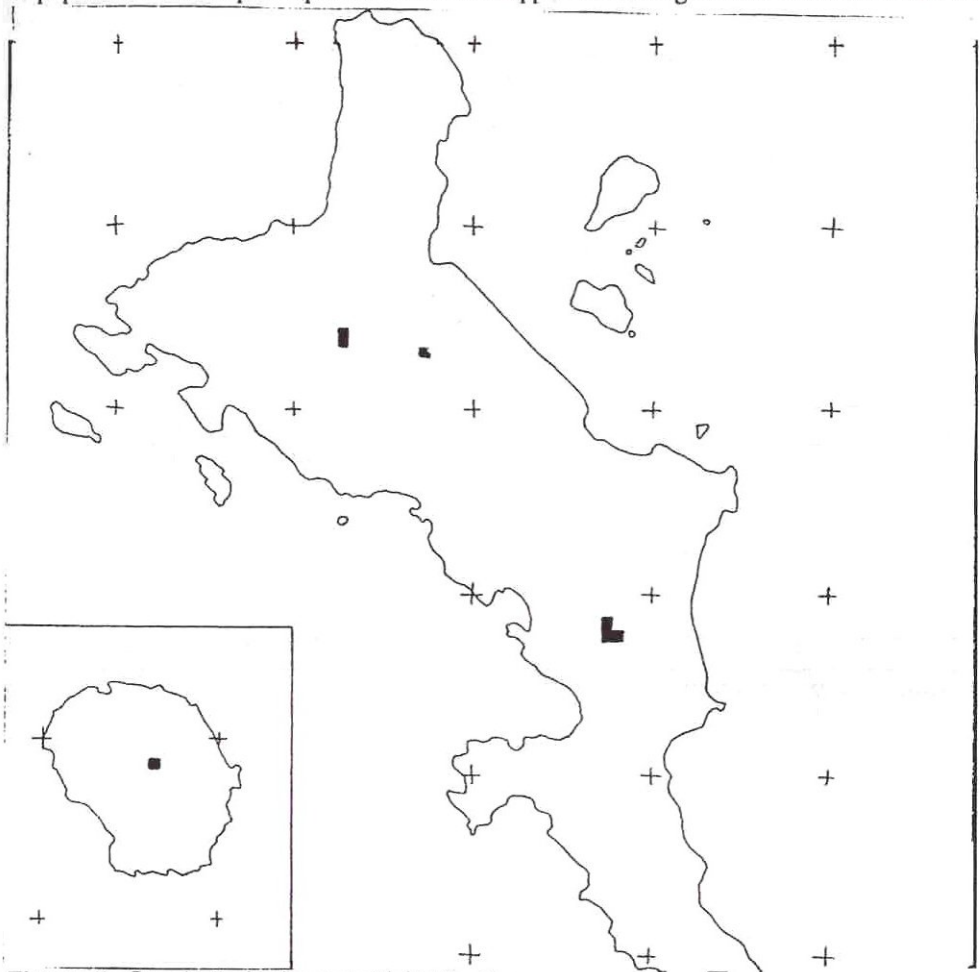


Figure 5 *Seychellaria thomasetti* distribution

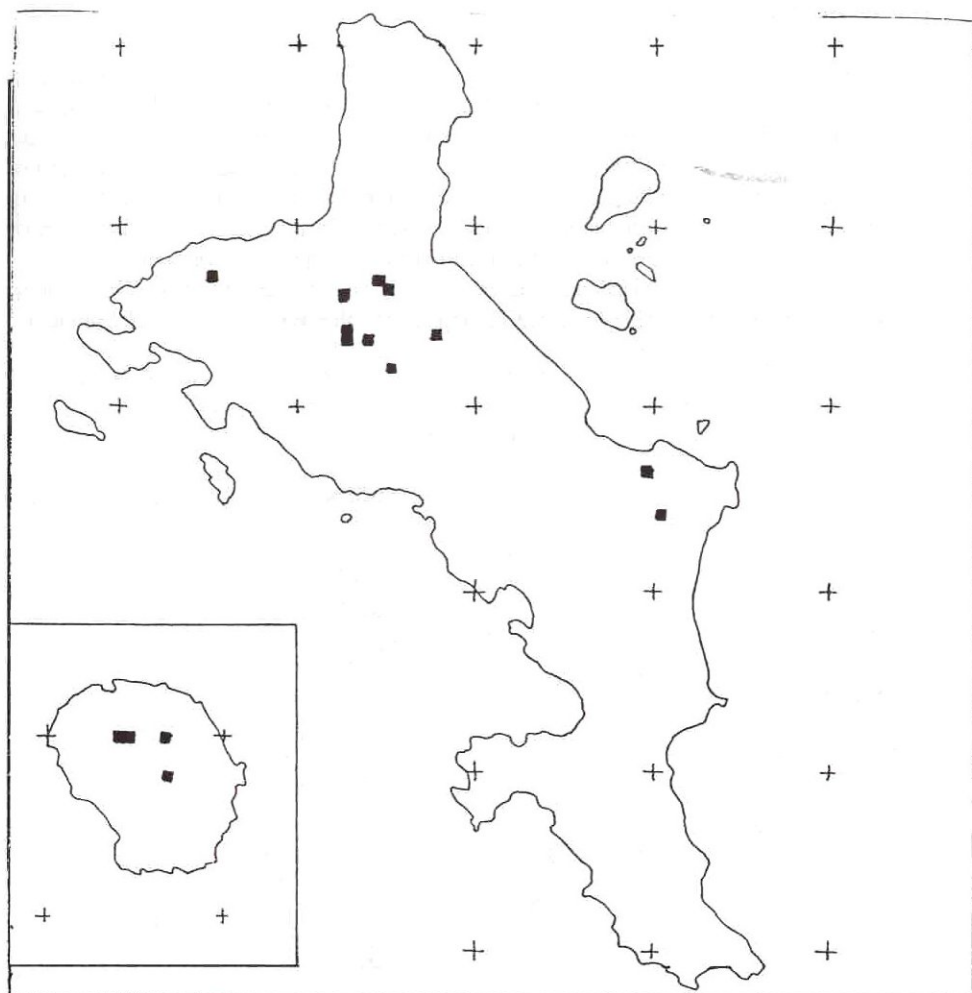


Figure 6 *Nepenthes pervillei* distribution

Summary of publications in 1992

Invasive Melastomataceae in Seychelles J. Gerlach

Oryx 27(1); 22-26

The distributions of two invasive species of Melastomataceae, *Clidemia hirta* and *Memecylon floribundum*, in the islands are outlined and the ecological consequences of their spread discussed based on data collected in 1990 and 1991. The south-east Asian species *Memecylon floribundum* Blume has not previously been recorded as a significant invader in Seychelles although herbarium specimens collected by P.R. Dupont record its presence on Mahe since 1931. It has not been reported as a weed in other areas. At present an area of approximately 3 km² is dominated by this species, from sea level to 400m altitude on Mahe. A density of 7.5 plants per square metre is reached. The dense canopy formed blocks out virtually all light. Where there are gaps in the canopy the ground is covered in *M. floribundum* seedlings.

The threat posed by *Clidemia hirta* (L.) D.Don in Seychelles was identified in 1990 by the Oxford University Silhouette Expedition. This Central-South American species was first recorded on Silhouette in 1987. There are no precise data on the introduction or spread until 1990 when it dominated some 2000m². By August 1991 *C. hirta* occurred over a large part of the island, having spread down to sea level. *C. hirta* grows only in very damp areas; the dry south of the island is virtually *C. hirta* free.

Due to the very high numbers of seeds per fruit and consequent efficient dispersal of *C. hirta* this species may be more of a serious threat to the ecology of Seychelles than *M. floribundum*. The control of this species is discussed, concluding that biological control is not advisable and that physical removal should be attempted.

The identity of two Euconulid snails recently found in the Seychelles Verdcourt

J. Conch. 34(3); 169-174

Two small snails collected in Seychelles are identified as *Liardetia sculpsia* (Möllerndorff) and *Louisia barclayi* (Benson). The former is known from Mauritius, Marianas Islands, Caroline Islands and SE. China and the latter from the Mascarenes and Diego Garcia.

Newsletter articles:

Lamellaxis mauritanus in Seychelles. J. Gerlach

Papustyla 1(92); 4

The land snail *Lamellaxis mauritanus* is reported from Mahé. This species was last recorded in Seychelles in 1869, it is probably an introduced species.

The conservation of Silhouette Island, Seychelles

I. Plants

Justin Gerlach,

Department of Zoology, South Parks Road, Oxford, OX1 3PS, U.K.

PO. Box 207, Victoria, Mahé, Seychelles.

Abstract: As the third largest of the granitic islands of Seychelles Silhouette supports a wide variety of localised plants and animals. The steepness of the terrain has prevented the extensive ecological damage by forest clearance that occurred historically on other Seychelles islands. Recent studies of the island's habitats have confirmed its great conservation value. The range and condition of habitats found on the island and the species found within them are outlined below. Specific conservation problems are described and proposals made to ensure its continued preservation.

Introduction

Situated in the western Indian Ocean, some 800km east of the African coast the Seychelles group of islands supports a wide range of habitat types, many of which have developed in isolation since the break-up of Gondwanaland. Silhouette is the third largest of the granitic islands, with a surface area of approximately 1600 hectares. It is approximately 19km north-west of the largest island, Mahé (see Map 1 insert), is the second highest in the group (maximum height 740m above sea level) and consequently is one of only two islands to support high altitude forests including extensive areas of primary montane forest. It is the least developed of the larger islands and has a population of fewer than 200 people in two small coastal settlements.

The island has important populations of rare animals, especially the Seychelles sheath-tailed bat (*Coleura seychellensis silhouettae*) (Nicoll & Suttie 1982), endemic Amphibia (Nussbaum 1984) and many endemic invertebrates. The flora includes several species that are now rare on other islands in Seychelles and a number of species are confined to Silhouette only, including a forest dominated by the endemic tree *Pisonia sechellarum* which was discovered in 1987 (Friedmann 1987). The steep slopes of the island and its rocky terrain have so far prevented development of the island and have served to protect its montane forests. The low altitude forests were extensively cleared in the 1930s but the forests above 400m are almost untouched, consequently Silhouette has the best remaining areas of montane forest in Seychelles.

In 1987 the Silhouette Marine National Park was established. This affords legal protection to the marine environment to a distance of 1km from shore, an area of 2,000 hectares. Within this zone only fishing for local consumption is permitted. The designation theoretically protects the off-shore zone from further ecological damage, although the effectiveness of this mechanism has not been documented. It appears from anecdotal reports

that the reefs around Silhouette have been extensively damaged, principally by coral formations being tangled in fishing and mooring lines. Whilst most coral heads are reported to be snagged by nylon lines it is probable that permanent damage may be prevented if further degradation from this source is stopped.

The terrestrial environment receives no official protection. The island is managed in a non-intensive manner that reflects the current management's (Island Development Company) interest in preserving the existing ecosystems of Silhouette. So far this has prevented extensive habitat destruction although the IDC's management objectives will be influenced by extrinsic economic factors which at times are likely to lead to a conflict with ecosystem conservation interests.

In 1990 the ecology of the *Pisonia sechellarum* forest on Silhouette was studied by the Oxford University Silhouette Expedition. This provided the first quantitative account of the ecology of the island. Observations made in 1991 and the findings of the expedition are combined in the following account of the status of habitats of Silhouette.

Habitats presently occurring on Silhouette

Although the geology of Silhouette differs from that of the other larger islands of Seychelles (being primarily comprised of syenite and microgranite instead of the more usual granitic rocks; Piggott 1968) the vegetation is broadly similar to that found on Mahe where the same altitudinal range occurs. The main habitats of Silhouette can be divided into 11 categories which are described below.

Although the flora of Seychelles is relatively well known, with extensive botanical collections dating back to 1931, few studies of ecological aspects of the vegetation have been undertaken. The first categorisation of definite habitat types based on floristics was proposed by Jeffrey (1962). This basic system of five natural habitats provides a general indication of habitat variation on the larger islands. Although subsequent accounts of the ecology of Seychelles do not explicitly use these habitat types and the precise nomenclature varies the five categories have been generally accepted (for example the account of the flora given by Friedmann, 1987, uses most of the categories described by Jeffrey). This was subsequently used as a basis for a more detailed classification by Proctor (1984).

Attempts to describe specific areas by the existing system of classification of the habitats of Seychelles (Proctor 1984), and to associate animal distribution with vegetation patterns, have revealed some shortcomings with the current habitat classification. Ongoing ecological research projects in the islands require a more detailed system that takes into account the extensive alterations to natural vegetation systems caused by human influences. In order to take these factors into account Proctor's system has been modified to draw attention to recently discovered vegetation types not previously included. Some of the names of the habitats used by Proctor (1984) have been altered to conform with more standard classifications applied to other areas such as those listed in White (1983). This system uses the categories provided by Proctor (1984) as a baseline, modifying and subdividing some categories to reflect localised habitat types of particular interest and un-natural habitats. Background information used in categorising the habitats is derived from personal observations (including unpublished data) and

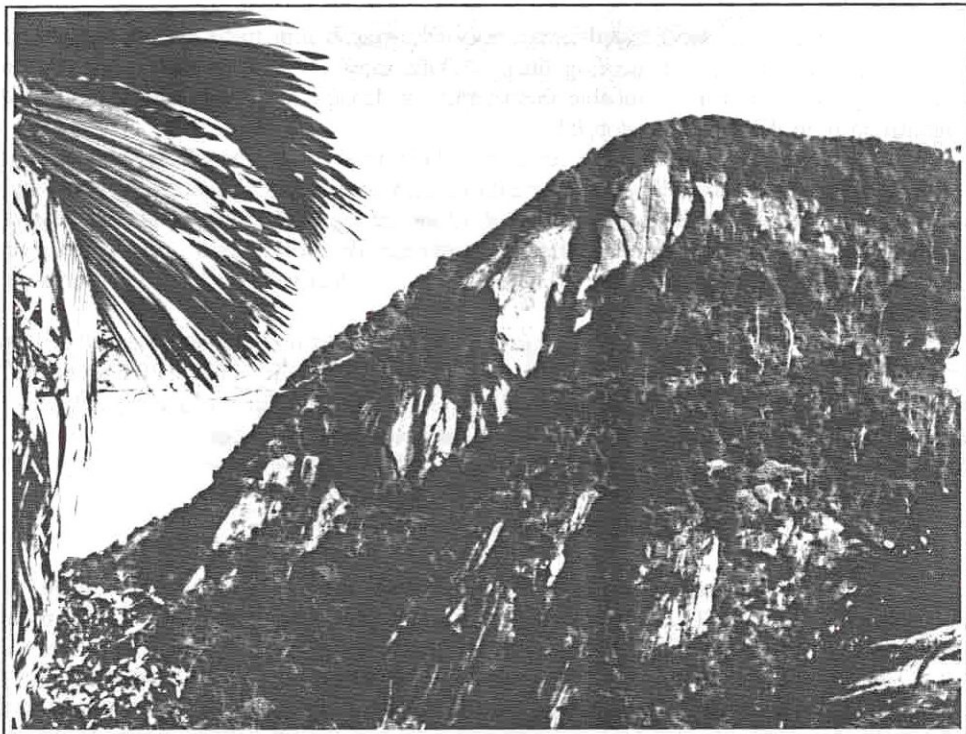


Figure 1. Mt. Dauban, Silhouette
(photo: J. Gerlach)

from several published sources (Friedmann 1986, Jeffrey 1962, Oxford University Silhouette Expedition 1990, Proctor 1984, Robertson 1987, Scott 1910).

The approximate distributions of the habitats are shown on Map 1. This map was prepared by outlining the main distinguishable habitats visible on the 1961 aerial survey photographs of the island, these were supported by characterisation of the habitats on the ground, using topographical features to confirm the location of the habitat boundaries. Habitat characterisation used the criteria described in the habitat descriptions below, on Silhouette all these areas are easily distinguishable. More detailed and accurate mapping is planned which will incorporate quantitative characterisation of the habitats.

1. Marsh habitats

- a). Mangroves.
- b). Lowland marsh - formed where the coastal plateau meets the base of the mountains. Largely drained or substantially altered by human interference. Naturally this habitat supports few aquatic plants (except algae and *Typha javanica* and the marsh fern *Acrostichum aureum*), marshes are usually bordered by lowland trees such as *Terminalia catappa*.

- c). High altitude marsh - occurs in valleys at around 300-500m above sea level. These marshes have been drained and modified for agriculture. Mare aux Cochons on Silhouette was naturally an area of standing water with *Typha javanica*, *Gynura sechellarum* and *Melastoma malabathricum* (Scott 1910). It is presently a deserted *Coffea* plantation with areas of *Clidemia hirta*. This habitat was not listed by Proctor (1984).
2. Littoral zone - areas of strand debris and habitats influenced by direct action of the sea. The vegetation comprises salt tolerant algae along the high tide mark and common Indo-Pacific strand plants; *Ipomea pescaprae*, *Cocos nucifera*, *Calophyllum inophyllum*, *Casuarina equisetifolia*, *Hibiscus tiliaceus* and *Scaevola sericea*.
3. 'Glacis' - large expanses of bare rock exposed to wind and direct sunlight, with plant growth in sheltered soil pockets.
 - a). lowland glacis - salt spray in this zone restricts the vegetation to xerophytic species except where sheltered valleys are present. Trees and shrubs include *Calophyllum inophyllum*, *Soulamea terminaloides* (this appears to have become extinct on Silhouette), *Mimusops sechellarum* and *Pandanus multispicatus*. In sheltered valleys *Dracaena reflexa* and orchids (*Polystachya* spp. and *Angraecum eburneum*) may be abundant. On Silhouette such areas are being invaded by the introduced species *Bryophyllum pinnatum*.
 - b). high altitude glacis - greater influence of clouds at high altitudes results in a habitat where *Nepenthes pervillei* is abundant. The commonest plant species in this habitat are *Pandanus multispicatus* and *Dicranopteris linearis*.
4. Scrub habitats - for the most part these are areas that have lost their native vegetation cover (category 4a. being the only exception), the main plant species in the secondary habitat are exotic weeds. A variety of indigenous plants do occur but at a low frequency. Scrub habitats were not considered by Proctor (1984) but should be recognised as they are usually highly distinct from surrounding habitats.
 - a). *Cyathea sechellarum* patches - the dominance of small tree ferns (stunted or immature) at the head of boulder filled valleys could be considered a scrub habitat. These contain a variety of creepers and are gradually replaced by forest. This ranges from almost pure *Cyathea* and *Angiopteris evecta* stands (as on Silhouette) to mixed forest (eg. Morne Seychellois, Mahe).
 - b). *Dicranopteris linearis* scrub - this is dominated by the exotic bracken fern which forms mats of dry fronds over 1m deep.
 - c). *Chrysobalanus icaco* scrub - occurs on eroded red earth slopes following deforestation. The vegetation structure is dense and regeneration of trees very slow or non-existent. Some native herbs and creepers may persist in damper areas.
 - d). *Clidemia hirta* scrub - *C. hirta* dominates a few small areas on Silhouette, its cover is variable in density; some palms do grow through and there are small numbers of herbs at ground level.

In addition to these areas of *Memecylon floribundum* scrub occur on Mahe, as yet this

has not been introduced to Silhouette (Gerlach 1993).

5. Coastal forests

- a). Typical coastal forest (now reduced to a few small patches) - this is a mixed forest type with a range of Indo-pacific trees, *Calophyllum inophyllum* and *Terminalia catappa* being the most abundant. *Intsia bijuga*, *Hibiscus tiliaceus* and *Cocos nucifera* are present, and, formerly, *Mimusops sechellarum*.
- b). Seabird island coastal forest - on islands with large seabird nesting colonies (eg. Aride and Cousin) coastal forest is dominated by *Pisonia grandis*, *Ficus* spp. and *Euphorbia pyrifolia*. *Rothmannia annae* is now restricted to coastal forest on Aride (with a few planted trees on Mahe). Only very small patches of this habitat ever occurred on Silhouette, all of these appear to have been destroyed earlier this century.

6. Agricultural areas (excluding tree plantations) - these areas are characterised by open vegetation with abundant and diverse growth of weeds. Lowland agricultural areas contain a variety of crop plants and invasive weeds.

7. Lowland forest - this is a largely exotic habitat type occurring on the plateaux of all islands. The natural forest would have been the coastal forest type. In its present form this is replaced by generally derelict plantations. Proctor (1984) combined lowland and coastal habitats, the separation of the two proposed here is intended to allow a distinction to be made between natural 'coastal' habitat and the 'lowland' habitat that has replaced it in most areas. The lowland forest in its present form is comprised of plantations of *Cocos nucifera* (or *Casuarina equisetifolia* on other islands), the understorey is invaded by *Cinnamomum verum*, *Leucaena leucocephala* and *Lantana camara*.

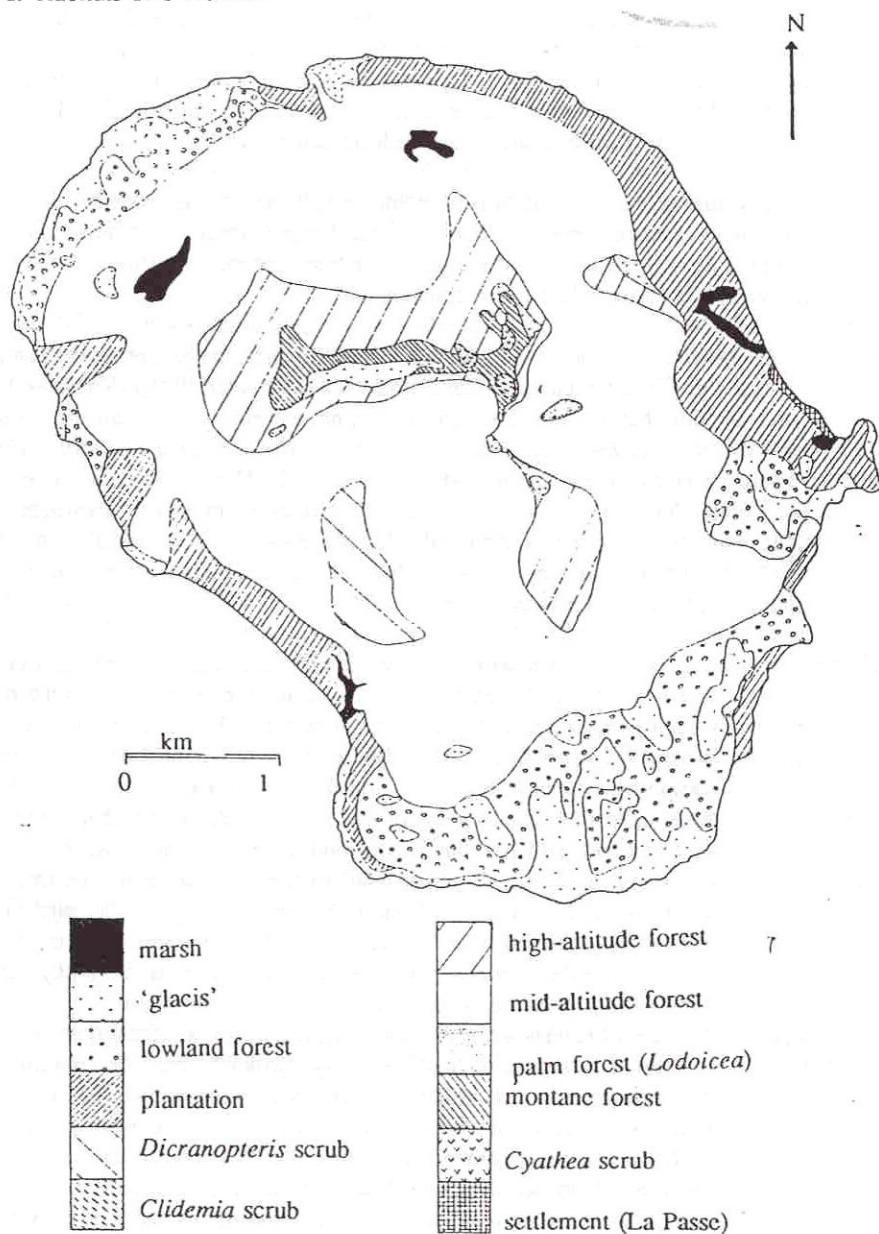
8. Mid-altitude forest - Proctor (1984) combined all forest habitats except lowland or coastal forest in 'moist forest habitat'. Mid-altitude, high-altitude and montane forest are separated in the system proposed here to draw attention to distinguishable types that are obscured in Proctor's system. There is considerable overlap of the habitats in these categories, all the constituent habitats appear to be easily recognisable on Silhouette.

- a). Natural intermediate forest - this is an intermediate habitat between coastal and high altitude forests. Several lowland tree species occur (notably *Calophyllum inophyllum*), but the increasing humidity and decreasing temperatures with altitude allow the occurrence of a variety of other species. The dominant tree species is *Dillenia ferruginea* and historically *Mimusops sechellarum* was abundant, this species is now uncommon, most large trees having been felled for timber. *Northea sechellana* rarely occurs in such forests. In drier areas *Diospyros sechellarum* and *Memecylon eleagni* may be abundant. Very little pure mid-altitude forest persists.
- b). *Cinnamomum verum* forest - plantations of this species have replaced the

- natural intermediate forest on most islands. *C. verum* has also spread from the plantations. *C. verum* forest has less diversity than the forest it has replaced although most species persist as isolated plants.
- c). *Psidium littorale* forest - this has invaded some areas, becoming the dominant forest tree in parts of Silhouette, floral diversity remains high in *P. littorale* forest on Silhouette (this is in marked contrast to the very low diversity of such habitat in the Mascarenes, Gueho 1988).
 - d). Tree plantations - plantations of several species exist such as *Hevea brasiliensis*, *Santoricum koetjape* and *Swietenia macrophylla*. These are all very low in diversity and have little understorey.
9. High-altitude forest - plantations were not established in this zone but invasion by *Cinnamomum verum* is extensive. The natural habitat resembles natural mid-altitude *Dillenia ferruginea* forest but the dominant tree species is *Northea sechellana*. *D. ferruginea* is an abundant forest constituent.
 10. Palm forest - this occurs in both mid- and high-altitude zones, corresponding to Proctor's dry forest habitats of slopes and valleys (Proctor 1984). Virtually all large trees in this habitat are Palmaceae (*Nephrosperma vanhouettarum*, *Roscheria melanochaetes*, *Phoenicophorium borsigianum* and *Verschaffeltia splendida*) or Pandanaceae (*Pandanus hornei* and *P. sechellarum*). There are a variety of epiphytes and herbs, although the covering of dead palm leaves limits non-arborescent forms. This habitat is reduced in area but where it survives it is virtually intact, with relatively little invasion by exotics. There is one area of palm forest on Silhouette dominated by the palm *Lodoicea maldivica*.
 11. Montane forest - this is the most specialised habitat in Seychelles. It occurs in typical form only above 600m although local climatic conditions may result in the required extremely high levels of humidity occurring down to 500m in a few valleys.
 - a). Mossy montane forest - *Northea sechellana* remains abundant with the progression from high-altitude forest but is not dominant. At the lower limits of the habitat a variety of tree species may be abundant, including *N. sechellarum*, *Dillenia ferruginea* and *Gastonia* spp. At higher levels *Glionettia sericea* is dominant and is often the only abundant tree species where stunted individuals (2-3m high) grow on ridges. The high humidity allows the profusion of rare hygrophilic plants and epiphytic moss growth may reach over 1m in depth. The moss also carpets the rocky substrate. *Nepenthes pervillei* is common in this habitat.
 - b). *Pisonia sechellarum* forest - as with typical mossy montane forest this occurs in a zone of extremely high humidity. Suitable climatic conditions exist down to 500m in one valley on Silhouette where this very restricted (0.48 hectares in area) habitat occurs. The dominant tree species is *P. sechellarum*, *Ficus* spp. are common. The high levels of light at ground level result in an abundant ground flora with many localised species, especially abundant is the fern *Asplenium nidus*. 5 species of plant have not

been recorded outside the forest.

Map 1. Habitats of Silhouette



Status of selected native plant species

Some 66 of the 75 endemic plants of Seychelles have been recorded on Silhouette (Robertson 1989 and personal observations). This is a very high proportion of the Seychelles endemic flora, making Silhouette the most floristically diverse island of its size in the region as is shown by the comparative data in table 1. Of these *Justicia gardineri*, *Schefflera procumbens*, *Achyropermum sechellarum*, *Carissa edulis* var. *sechellensis*, *Pisonia sechellarum*, *Psychotria silhouettae* and *Pseuderanthemum* aff. *tunicatum* are known only from Silhouette, with unidentified *Acacia* sp. and *Piper* sp. being possible endemics (the last 5 being restricted to one small boulder field 0.48 hectares in area). In addition Silhouette is one of only two islands to support *Seychellaria thomassetii* and *Nepenthes pervillei*.

8 of the recorded species appear to have become extinct on the island, these are *Impatiens gordonii*, *Soulamea terminaloides*, *Canthium carinatum*, *Rothmannia annae*, *Rapanea sechellarum*, *Coleus subfruticosus* and *Bakerella clavata sechellensis*. Suitable habitat survives for the reintroduction of most of these species. The reasons for their extinctions are unknown but in the case of *Rothmannia annae* at least, it is most probable that clearance of all the larger lowland forests resulted in the loss of all trees. Many seedlings have been grown on Mahe and several of these should be available for replanting on Silhouette in the near future.

There is a small forest of *Lodoicea maldivica* at the source of the Grande Riviere. Although this is an unnatural forest type on Silhouette (having been planted in the 1950s, H. Dauban pers. comm.) it is of considerable interest as the only self-sustaining population of this palm outside of Praslin and Curieuse.

Table 1.

| Island | Island area (km ²) | % Seychelles endemics | Endemics/area |
|------------|-----------------------------------|--------------------------|-----------------------|
| Mahé | 14.48 | 88 | 4.56km ⁻² |
| Praslin | 4.04 | 40 | 7.43km ⁻² |
| Silhouette | 1.60 | 88 | 41.25km ⁻² |
| La Digue | 0.96 | 15 | 11.46km ⁻² |

Conservation status of the island

The steepness of the island has prevented development of most areas above the coastal plateaux. Extensive areas of lowland forest were cleared in the early years of this century (H. Dauban pers. comm.) but the higher-forest regions have remained largely intact. The factors that protected these forests from agriculture and forestry in the 1920s and 30s still serve to prevent development of the island's interior. Although there has been some expansion of agriculture around La Passe it is unlikely that this will spread much beyond its current

boundaries. Degradation of Silhouette's ecosystems could come from two sources, tourism and invasion of habitats by introduced plants.

A large increase in the number of tourists visiting the island would cause damage if a significant proportion of them used the paths crossing over Jardin Marron. It is extremely unlikely that erosion on these paths will increase in the foreseeable future due primarily to the limited availability of tourist accommodation on the island. The concentration of the Silhouette Island Lodge Hotel on quiet, secluded holidays should help to safeguard against significant ecological damage being caused by tourism. The more sensitive paths such as along the ridge of Mt. Dauban are very susceptible to erosion but are fortunately too difficult to attract more than one or two visitors a year.

The most serious threat is posed by the ongoing process of vegetation replacement. Of the 270 plants presently recorded from Silhouette 104 are introduced species. Of these several have proved to be invasive on the island. Species that appear to be invading natural, or semi-natural, habitats but are presently uncommon or localised include *Cola nitida*, *Leucaena leucocephala*, *Chrysobalanus icaco*, *Syzgium carophyllus*, *Cinnamomum verum* (this species has invaded many habitats on other islands but is relatively insignificant on Silhouette), *Tabebuia pallida*, *Lantana camara*, *Hevea brasiliensis*, *Ananas comosus* and *Furcraea foetida*. Several species have spread widely over the island and dominate many areas, these are considered in more detail below:

Clidemia hirta

This species was recognised as a serious problem by the Oxford University Silhouette Expedition 1990. It dominates large areas and prevents natural regeneration through its dense foliage shading out seedlings. Its fruits are dispersed by birds and it spreads locally by shoots from creeping stems which attach to the ground by shallow surface roots. This allows it to grow on very shallow soils and germinate epiphytically. On Silhouette growth seems to be limited by light availability. It dominates areas where there is little shading caused by tree cover. Where trees occur but light penetrates, as on the summit of Mt. Dauban, it forms a dense undergrowth. It is distributed throughout Silhouette and its most important feature is that it will grow rapidly when a clearing is created by land-falls or tree-falls. Thus there is very little doubt that it will continue to spread. If unchecked there is no apparent reason why it should not eventually completely dominate the whole island. Its dispersal abilities mean that it will spread to other islands and continue the process. A survey in 1991 indicated that the problem was even more advanced than in 1990 and that complete eradication of *C. hirta* was impossible. Consideration of the alternatives leads to the conclusion that the only acceptable means of controlling the species is to uproot the main patches and to burn them in localised areas (Gerlach, 1993 in press).

Psidium littorale

This species is one of the most invasive plant species on Mauritius where it dominates forest habitat, excluding most other plants (Gueho 1988) and providing poor habitat for indigenous animals. The spread of this species may be facilitated by the presence of large, highly mobile dispersers such as monkeys and pigs. In the absence of these it appears to spread less rapidly and on Silhouette, although abundant, *P. littorale* forest does not seem to be spreading at a great rate. Observational records indicate that there is a relatively high

speci should diver be in saplin es. C the h gh rege create a mo more degr sity in *P. littorale* invaded areas and that indigenous plants persist. These forests monitored in the light of the potential threat this species poses. Habitat restoration would primarily comprise planting and maintaining indigenous tree saplings. Cutting of established *P. littorale* trees or saplings would not be beneficial due to the high regenerative capability of this species, the resultant coppiced stands would probably shade and occupy more space than the current growth forms, this would represent a more degraded habitat than presently occurs.

Paravarianth es falcataria

The characteristic large, flat topped trees are the distinctive feature of the island. The reputation for being a highly invasive species. Whilst its invasive capabilities are not in doubt it is certain that the significance of the threat it poses has been overstated. This view is confirmed by the forests of Silhouette which maintain a high diversity and abundance of indigenous trees despite the apparent dominance of *P. falcataria*. The extremely open nature of the canopy of these trees results in the shading effects of the foliage being negligible. The trunks and roots do occupy a very large area and thus do compete for space with other species but this is rarely considered a major ecological limitation. On this basis immediate control of this species is not a priority. As an abundant exotic species it would be desirable to reduce its abundance. Felling the large trees would be excessively destructive with extensive damage caused to adjacent trees, it would be advisable to use a more gradual process of ring-barking selected trees, which would also reduce the problems of the rapid regeneration of the species in clearings caused by felling. This form of management has recently been initiated to remove some of the trees around the Grande Riviere in order to protect the water supply of La Passe. The current management of Silhouette perceive the presumed high water requirements of these large trees as a threat to the limited water flow in the Grande Riviere (Revere pers. comm.).

Syzygium jambos

Dense stands of this species do occur in small areas, the most apparent one being on the west side just below the top ridge of Jardin Marron. There are no quantified data on the diversity of *S. jambos* dominated habitat, the small areas concerned make observational evidence of doubtful value but it is worth recording that some indigenous species do occur but that abundance appears to be very low, probably because of the very dense shade cast by the low *S. jambos* canopy at about 4-5m above the ground.

Management of these habitats is unlikely to achieve complete eradication of the stands due to the high regenerative ability of the species. The aim of management of *S. jambos* should be to increase the abundance of indigenous species through planting, especially of taller forest tree species which would eventually produce a canopy above the *S. jambos* canopy and thus shade out the stands, causing a decrease in the density of *S. jambos* in the areas concerned.

Tabeaia pallida

An area of *T. pallida* forest exists above Grande Barbe. This open forest appears to have a low diversity, it is not clear if this is a natural feature of the area or a consequence of *T. pallida* dominance. The excellent dispersal abilities of this species make it a potentially

serious invader. It does not tend to dominate large areas on other islands so is probably not an immediate threat. The small forest should be gradually replaced by planting indigenous species between existing trees and selectively removing the *T. pallida* when appropriate.

Hevea brasiliensis

The plantation of this species above La Passe is of no commercial value and is not utilised. It represents a very unnatural habitat with very little ground vegetation growing through the thick carpet of dead leaves. In the dry area in which it occurs this plantation may be a fire risk. Additionally the explosive dispersal mechanism of the seeds means that the presently small plantation is capable of rapid expansion. As for *T. pallida* the diversity of the area should be increased and the abundance of *H. brasiliensis* gradually reduced.

Artocarpus heterophyllus

Although very abundant and widely dispersed the effects of this species are not clear. It is obviously a major component of the diet of fruit bats and as such may be of importance in the maintenance of Silhouette's large population of the species. The seeds and fruit are very frequently consumed by rats, its role in the rats' diet may be serving to reduce pressures on large seeded indigenous trees, such as *Northea sechellana* which appear to seed and germinate more frequently on Silhouette than on other islands. It is important that the diet of rats be determined to provide information on which plant species are suffering high levels of seed predation, whether any resident bird species are under threat and to determine if reducing the abundance of *Artocarpus heterophyllus* would lead to an undesirable increase in seed predation on other species.

The control of invasive introduced plants on Silhouette is the most important step that can be taken to preserve the ecosystems of the island. As the most natural and diverse of the granitic islands of Seychelles the preservation of Silhouette should be considered a high priority in the maintenance of biodiversity in the western Indian Ocean region. If the threats posed by these species can be minimised (through the implementation of at least some of the measures suggested above) the rare endemic plants and animals of Silhouette should not be at any serious risk of extinction. The security of this important island would be enhanced if the legal protection given to the off-shore zone around Silhouette were extended to cover the terrestrial environment. Whilst the current management practices do not endanger the currently existing habitats official legal protection would help to ensure their long term survival. It should be emphasised that protection of the forests of Silhouette would not conflict with the management practices currently being used by the Island Development Company on Silhouette.

Acknowledgements

I am grateful to the Island Development Company management on Silhouette and the people of Silhouette for assistance during the Oxford University Silhouette Expedition 1990 and subsequent visits. Dr. M.J. Coe provided useful comments and advice on the preparation of the manuscript.

References

- Friedmann, F. 1987.
Flowers and Trees of Seychelles. ORSTOM, Paris.
- Gerlach, J. 1993.
 Invasive Melastomaceae in Seychelles. *Oryx*, **27**(1):22-26.
- Gueho, J. 1988.
La Vegetation de l'ile Maurice. Editions de l'Océan Indien, Mauritius.
- Jeffrey, C. 1962.
The botany of Seychelles. London.
- Nicoll, M. & Suttie, J. 1982.
 The sheath-tailed bat in the Seychelles islands. *J. Zool.* **197**; 421-426.
- Nussbaum, R.A. 1984.
 Amphibians of the Seychelles. in *Biogeography and ecology of the Seychelles islands* (Stoddart D.R. ed.), Junk, The Hague.
- Oxford University Silhouette Expedition 1990.
 Final Report.
- Piggott, C.J. 1968.
 A soil survey of the Seychelles. *Min. Overseas Dev. Tech. Bull.* **2**. Overseas Surveys, England.
- Proctor, J. 1984.
 Vegetation of the Seychelles. pp193-207 in *Biogeography and Ecology of the Seychelles Islands* (Stoddart, D.R. ed.) Junk, The Hague.
- Robertson, S.A. 1989.
Flowering Plants of Seychelles. Royal Botanic Gardens, Kew.
- Scott, H. 1910.
 Eight months entomological collecting in the Seychelles Islands.
Trans. Linn. Soc., Lond. (Zool). **14**: 24-39.
- White, F. 1983.
 The vegetation of Africa. UNESCO, 1983.

The conservation of Silhouette Island, Seychelles

II. Animals

Justin Gerlach,
Department of Zoology, South Parks Road, Oxford, OX1 3PS, UK.
PO. Box 207, Victoria, Mahé, Seychelles.

Abstract: Silhouette is the third largest of the granitic islands of Seychelles and, as such, supports a wide variety of localised plants and animals. The extensive ecological damage by forest clearance that occurred historically on other Seychelles islands has been prevented by the steepness of the terrain on Silhouette. Recent studies of the island's habitats have confirmed its great conservation value. The status of the species of animals recorded on the island are discussed below and specific conservation problems are described.

Introduction

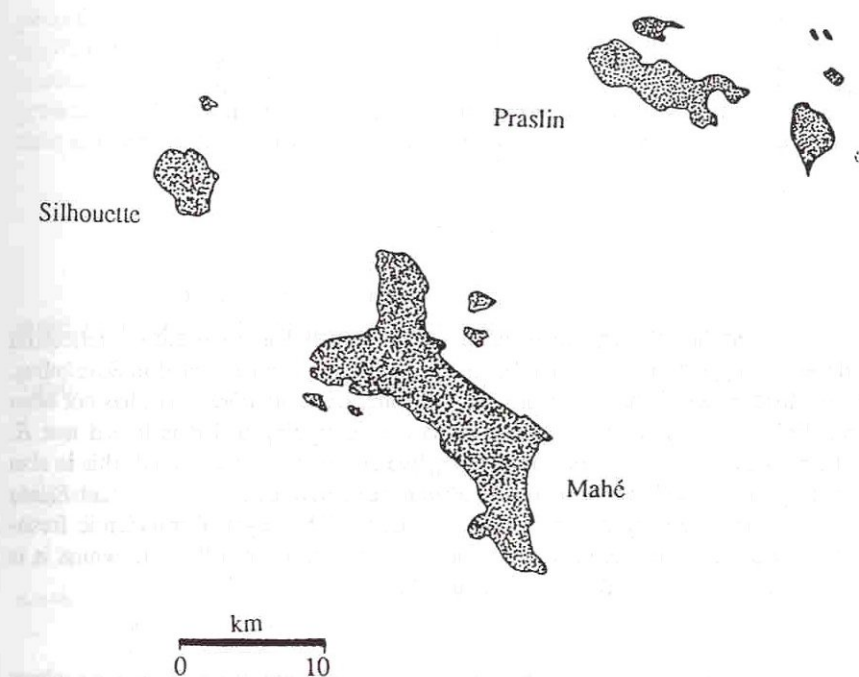
The Seychelles group of islands is situated in the western Indian Ocean, some 800km east of the African coast. They support a wide range of habitat types which have been isolated since the break-up of Gondwanaland. With a surface area of approximately 1600 hectares Silhouette is the third largest of the granitic islands. It is approximately 19km north-west of the largest island, Mahé (see Map 1), is the second highest in the group (maximum height 740m above sea level) and consequently is one of only two islands to support high altitude forests including extensive areas of primary montane forest. It is the least developed of the larger islands and has a population of fewer than 200 people in two small coastal settlements.

The island has important populations of rare animals. The flora includes several species that are now rare on other islands in Seychelles and a number of species are confined to Silhouette only, including a forest dominated by the endemic tree *Pisonia sechellarum* which was discovered in 1987 (Friedmann 1987). Low altitude forests were almost all cleared in the 1930s but the forests above 400m remain intact, as a consequence the best remaining areas of montane forest in Seychelles are found on Silhouette.

The establishment of the Silhouette Marine National Park in 1987 gave legal protection to the marine environment to a distance of 1km from shore, an area of 2,000 hectares. The effectiveness of the park in protecting the off-shore zone has not been documented, though anecdotal reports indicate that the reefs around Silhouette have been extensively damaged as a result of coral heads being tangled in fishing and mooring lines. The

terrestrial environment is not officially protected although the island is managed in a non-intensive manner reflecting the current management's (Island Development Company) interest in preserving the existing ecosystems of Silhouette.

In 1990 the ecology of the *Pisonia sechellarum* forest on Silhouette was studied by the Oxford University Silhouette Expedition. This provided the first quantitative account of the ecology of the island. Observations made in 1991 and the findings of the expedition are combined in the following account of the status of the fauna of Silhouette.



Map 1. Silhouette; areas mentioned in the text and location within Seychelles

Invertebrate fauna

In common with the other islands of Seychelles very little is known of the invertebrates of Silhouette. Most of the terrestrial species recorded occur predominantly in the leaf litter, such as the two species of leech endemic to Silhouette (*Idiobdella seychellensis* and *I. daubani*). The limited information on the terrestrial invertebrates is summarised in table 1.

Table 1. Invertebrates recorded on Silhouette

| Group | Number of species | % of Seychelles endemics | % endemic to Silhouette |
|-----------------|-------------------|--------------------------|-------------------------|
| Nemertines | 1 | 100 | 0 |
| Leeches | 2 | 66 | 100 |
| Molluscs | 33 | 66 | 24 |
| Schizomids | 1 | ? | 0 |
| Spiders | 31 | ? | ? |
| Opilionids | 2 | ? | 0 |
| Pseudoscorpions | 2 | ? | 0 |
| Scorpions | 1 | 100 | 100 |
| Isopods | 2 | ? | 0 |
| Millipedes | 6 | ? | ? |
| Centipedes | 6 | ? | ? |
| Insects | ? | ? | ? |

Molluscs

The only invertebrate group for which accurate species lists exist are the terrestrial molluscs. Silhouette supports a greater number of species than any other island in Seychelles. Most indigenous species occur and are secure and only one, *Edentulina moreleti*, has not been recorded since 1972. Surveys of the mollusc fauna are continuing and it is hoped that *E. moreleti* can be relocated, if so it is essential that no live specimens are collected (this is also true for *Gulella* sp., *Imperturbatia praetumida*, *Priodiscus serratus*, *P. spinosus* and *Pilula mahesiana*, all of which are very uncommon or localised). The Seychelles endemic freshwater snail *Paludomus ajanensis* is very common and widespread on Silhouette whilst it is restricted and very rare on Mahé (Brown & Gerlach 1991).

Arthropods

The small endemic scorpion, *Lychas braueri*, is known only from Silhouette where two specimens have been found (one in 1908 and another in 1990). It is almost certainly naturally rare and is best protected by conservation of the natural forest habitats. Other very rare arthropods include an undescribed species of centipede (*Scutigera* sp.) which is known from very few specimens (3 were found in 1990). The pill millipede *Sphaerotherium forcipatum*, though rarely collected is not uncommon in the montane forest. Although it was first recorded on Marianne in 1892 (where it is probably extinct) and also occurs on Mahé (one specimen recorded by the author in 1991), Silhouette is the only island where it is not extremely rare, and can thus be considered the stronghold of the species.

The insect fauna contains many uncommon species. In general these are all best protected by forest conservation. Several taxa have rarely been recorded and probably occur

in very low numbers, although apparent rarity reflects a lack of collection in most cases. Of the rare endemic species the stick insect endemic to Silhouette, *Carausius scotti*, depends upon the birds nest fern, *Asplenium nidus*, for its food. As this is notably abundant on Silhouette the species is not in danger despite being believed to be extinct until 1990 (Matyot 1990a&b). All insect groups require further research in all areas of the island. Studies on the introduced species, particularly the ants *Anoplolepis longipes* and *Technomyrmex albipes* (although this may possibly be an indigenous species), would be of interest as these may influence the abundance and distribution of indigenous taxa. The seed eating Platypodid beetles should also be studied to determine their effects on the vegetation dynamics of the island. Particular attention should be paid to possible predators of exotic plants (especially of *Clidemia hirta*), and also to predators of the rarer endemics.

Freshwater and littoral crustacea do not appear to be at risk, all recorded species still persist. The only species that could be threatened by human exploitation, the freshwater crayfish *Macrobrachium lar* is still common in some freshwater pools. The carapaces of marine crustacea are very common at Grande Barbe and Silhouette residents confirm the persistence of large numbers of edible marine crustacea around Silhouette. This is virtually unique in Seychelles, where stocks of such species have been seriously depleted.

Vertebrate fauna

Most of the species of vertebrate recorded in Seychelles occur on Silhouette; the numbers of species of amphibians and reptiles are summarised in table 2.

Table 2. Number of species of amphibians and reptiles recorded on Silhouette

| | Seychelles total | Silhouette |
|--------------------------|------------------|-------------|
| Amphibians | | |
| caecilians (all endemic) | 7 | 5 |
| frogs - endemic | 3 | 3 |
| introduced | 1 | 1 |
| Reptiles | | |
| chameleon (endemic) | 1 | 1 |
| snakes - endemic | 2 | 2 |
| introduced | 1 | 0 |
| skinks (all endemic) | 4 | 3 |
| geckoes - endemic | 4-5* | 4 |
| introduced | 2 | 1 |
| terrapins (indigenous) | 2-3 | 1? |
| marine turtles | 2 | 2 |
| tortoises (endemic) | 1 (extinct) | 1 (extinct) |

* The taxonomy of the *Phelsuma* geckoes is confused

Amphibians

The amphibian fauna of Silhouette is of particular importance. The island supports 9 of the 11 species found in Seychelles (Nussbaum 1984). Of these 8 are endemic to the

group. Only Mahé has more species (10). 4 caecilian species are recorded from Silhouette. They are rarely seen and little is known of their status.

Reptiles

Of the 17 terrestrial and freshwater reptiles of Seychelles 15 have been found on Silhouette. Little is known of their status, although most species appear to be abundant. The bronze house gecko, *Ailuronyx sechellensis*, was believed to have become extinct on the island until it was relocated in 1990, 4 individuals were found suggesting that it is not as rare as was believed. Research into the effect of rats on this species should be carried out as rats are generally believed to be the main cause of its rarity on many islands (Cheke 1984). Its coexistence with rats on Silhouette may cast some doubt on this idea, suggesting that more subtle habitat factors may be more relevant. With the current absence of any concrete evidence identifying rats as predators of reptiles in Seychelles it is not appropriate to place excessive stress on this threat.

An unidentified terrapin, *Pelusios* sp., has been recorded on Silhouette (Bour 1984). The distribution and identity of the Silhouette terrapins need to be determined and an assessment of numbers made. As the three species recorded from Seychelles are very rare on all the islands, and declining as the marshy habitat they require is drained, their conservation on Silhouette is of great importance. Rehabilitation of the marsh at Mare aux Cochons would help to improve their prospects.

Of the marine turtles the hawksbill, *Eretmochelys imbricata*, still nests on the beaches. Little is known of the numbers using Silhouette as a nesting ground and nothing is known of the hatching success. It is probable that considerable human disturbance of suitable nesting areas makes Silhouette a poor site for this species; it has been estimated that only 25 females use Silhouette for nesting beaches each year (Frazier 1984, Mortimer 1984). The green turtle *Caretta caretta* was recorded nesting on the island at the beginning of the century but has not done so for many years (Frazier 1984). The Seychelles giant tortoise *Geochelone arnoldi* used to occur on Silhouette (recorded in 1771 and 1787) until it was exterminated there in the 1800s (Bour 1984). A captive group of four adult Aldabra giant tortoises *Geochelone gigantea*, is held at La Passe.

Fish

Two species of indigenous freshwater fish are found in Seychelles; the rough-backed kill-fish, *Pachyplanchax playfairi*, and the eel *Anguilla bicolor*. Both occur on Silhouette but have probably declined with the loss of the fresh-water marshes. *P. playfairi* still occurs in the drainage ditches at Mare aux Cochons. In the mangroves there are a large number of juvenile marine fish and mudskippers, *Periophthalmus* spp. The nursery these habitats provide for marine fish makes them extremely important economically as well as ecologically. It is important that the relatively good condition of Silhouette's mangroves is maintained.

Mammals

The Seychelles sheath-tailed bat (*Coleura sechellensis silhouettae*) was recorded on Silhouette in 1915 and the 1980s (Nicoll & Suttie 1982). Recent sightings have not been confirmed. The roosts of the species on Praslin and La Digue are in caves. Suitable areas for the presence of roost caves occur around Mt. Dauban, Mt. Pot a Eau and at Gratte Fesse. The

latter area was explored by the Oxford University Silhouette Expedition 1990 and although it seemed possible that suitable sites might exist in the granite massif no traces of a bat population were found. Observations around the rocks were made at dusk in addition to searching for easily accessible caves, neither method provided any sightings. It seems that this species is very rare on Silhouette, as it is on the other islands. One possible cause of a decline may have been the drainage of the marsh at Mare aux Cochons. A fast flying bat with relatively little manoeuvrability would seem more adapted to hawking for insects over open areas of mountain marsh or mangrove than feeding within structurally complex woodland.

Seychelles fruit bats (*Pteropus s. seychellensis*) are distinctive on Silhouette for their frequently diurnal habits. On other islands they are almost entirely nocturnal whereas on Silhouette fruit bats can frequently be seen flying and feeding throughout the day and night. It is probable that this is due to a general lack of disturbance. The low human population causes little disturbance to the forest habitats where the bats are most frequent and although bats are frequently shot with catapults for food the scale of hunting is certainly far less than on Mahé. A survey of the numbers of fruit bats on Silhouette would be of interest as it appears that population density, and possibly total population size, is far higher on Silhouette than elsewhere in Seychelles.

Introduced black rats (*Rattus rattus*) are very common all over Silhouette. They appear to feed primarily on jack fruit (*Artocarpus heterophyllus*) and there is no evidence of them attacking other fruit or seedlings on Silhouette, thorough studies are required to validate these observations. Small numbers of the snail *Stylodonta unidentata* are eaten by rats, other animals are also probably only rarely attacked (this is deduced from the rarity of snail predation - such predation is typically extremely high where rats occur in any numbers; personal observation). Studies of diet and abundance are a priority. Rats are generally held to be responsible for the declines in a great variety of animal and plant populations, despite this the data for such a role are usually very poor. Cats (*Felis cattus*) do occur both around settlements and in the forest and it is not known what proportion of these are feral. Cats are known to hunt rats at night at Jardin Marron and have been observed in the forest by day, although only rarely. Tenrecs (*Tenrec ecaudatus*) are absent from the island. These introduced predators of invertebrates and small vertebrates are found on Mahé and Praslin, their effects on the native fauna are not known.

Birds

The avifauna of Silhouette is relatively low in species diversity. None of the endangered birds of Seychelles are definitely known to occur on the island. Despite this the bird life is of interest, due primarily to the abundance of indigenous species; of the land birds Seychelles kestrels (*Falco aerea*), bulbuls (*Hypsipetes crassirostris*), sunbirds (*Nectarinia dussumieri*) and blue pigeons (*Alectroenas pulcherrima*) are abundant. White-tailed tropic birds (*Phaethon lepturus*) are the most numerous sea-bird. The tropic bird population is clearly the highest found on any of the larger islands of the group and Silhouette's breeding population may rival the well known population on Aride. Other sea-birds are uncommon, fairy terns (*Gygis alba*) breed in low numbers and most of the other terns regularly occurring or breeding in Seychelles occur as non-breeding visitors to the island.

Of the rarer land bird species green parakeets (*Psittacula eupatria wardii*) formerly occurred on Silhouette until their extinction in the late 1880s. The introduced grey-headed

lovebird (*Agapornis cana*) is also extinct. Other species have not been definitely recorded by ornithologists but reports of scops owl (*Otus insularis*) and a species of white-eye (*Zosterops* sp.) seem reliable. The owl is reputed to have been heard frequently by the islanders until the 1950s or 60s but is no longer encountered and playback of tape lures in 1990 failed to provide any evidence of continued persistence, however these were only carried out in a very limited area. In the light of the considerable uncertainty regarding all aspects of the biology of this species it is not useful to speculate as to possible causes of apparent extinction. Further surveys should be carried out to determine if it is possible that a small population may survive. White-eyes (*Zosterops* sp.) have been reported several times but the identity of the species never confirmed. The species seems to have been abundant in the 1920s but declined as the plantations were extended in the 1930s and 40s. They have not been reported recently although they may have been heard in 1979 (Greig-Smith pers. comm.). Much suitable habitat exists, most of it is very rarely visited and populations may persist.

Cattle egrets (*Bubuculus ibis sechellarum*) have recently colonised the island, in 1991 there was a population of 7 at La Passe. It is not known if these will form a permanent breeding population. Green-backed herons (*Butoroides striatus degens*) are very common around the coast, the total population probably comprises several hundred pairs. Small numbers of moorhens (*Gallinula chloropus meridionalis*) occur around the marshy areas of Grande Barbe.

Of the introduced land-birds feral pigeons (*Columba livia*) are very common at La Passe. The barn owl (*Tyto alba*) has a small resident population on the island. Indian mynahs (*Acridotheres tristis*) are common in lowland areas, particularly around settlements. They also occur in the mountain forests but do not appear to be resident in these areas. In most places where mynahs are common they have been blamed for declines in indigenous land-bird populations. There is no evidence for this in Seychelles, although they are often cited as a conservation problem. On Silhouette they do not appear to be a cause for concern. The Indian house crow (*Corvus splendens*) was recorded on the island in 1978/9 (Greig-Smith 1986) but there have not been any subsequent records. It is to be hoped that their continued rarity on Mahé will prevent colonisation of other islands. Madagascar fodies (*Foudia madagascariensis*) and barred ground doves (*Geopelia striata*) are uncommon on the island and are generally restricted to relatively open lowland areas. The Madagascar turtle dove (*Streptopelia p. picturata x rostrata*) is not common on Silhouette as the forest clearings it requires are scarce. Silhouette does not attract large numbers of migrant waders but a variety of species have been recorded recently.

Conclusions

Development of the island has been almost entirely limited to the coastal plateaux due to the steepness of its interior. The high-forest areas have remained largely intact although the clearance of lowland forest was extensive in the early years of this century (H. Dauban pers. comm.). The agricultural area around La Passe has expanded in recent years but it is unlikely that this will spread much beyond its current boundaries.

The main threats to Silhouette's ecosystems are from tourism and invasion of habitats by introduced plants. Due to the extreme fragility of the montane habitats occurring on very steep slopes tourism could cause damage if a large increase in numbers was accompanied by a significant proportion of visitors using the paths crossing over Jardin Marron. Such an

increase in tourist numbers is unlikely to occur due to the limited availability of tourist accommodation on the island, the concentration of the Silhouette Island Lodge Hotel on quiet, secluded holidays should help to safeguard against significant ecological damage being caused by tourism. The more sensitive paths such as along the ridge of Mt. Dauban are very susceptible to erosion but are fortunately too difficult to attract more than one or two visitors a year.

The most serious threat is posed by the invasion of sensitive habitats by introduced plants. Currently available species lists include 104 introduced plant species out of a total of 270 plants recorded from the island. Several species have spread widely over the island and dominate many areas (some of these are considered in detail in Gerlach 1993), these include *Clidemia hirta*, *Psidium littorale*, *Paraserianthes falcata* and *Artocarpus heterophyllus*. Control of these species is the most important step that can be taken to preserve the island's ecosystems.

Silhouette is the most natural and diverse of the granitic islands of Seychelles and as such its preservation must be considered a high priority if the biodiversity of the western Indian Ocean region is to be maintained. None of the vertebrates recorded are endemic to the island but appear to be present in larger numbers and more natural habitats than on the other Seychelles islands. The information on the invertebrate fauna indicates that many species are endemic to Silhouette, many of those found on other islands seem to be most secure on the island. If control of invading plant species can be achieved the rare plant and animal species of Silhouette should not be at any serious risk of extinction. Extension of the legal protection currently afforded to the off-shore zone around Silhouette to cover the terrestrial environment would further enhance the security of this important island.

Acknowledgements

I am grateful to the Island Development Company management on Silhouette and the people of Silhouette for assistance during the Oxford University Silhouette Expedition 1990 and subsequent visits. Dr. M.J. Coe provided useful comments and advice on the preparation of the manuscript.

References

- Bour, R. 1984.
Taxonomy, history and geography of Seychelles land Tortoises and fresh-water Turtles. in *Biogeography and ecology of the Seychelles islands* (Stoddart D.R. ed.), Junk, The Hague.

- Brown, D.S. & Gerlach, J. 1991.
On *Paludomus* and *Cleopatra* (Thiariidae) in Africa and the Seychelles islands. *J. Moll. Stud.* 57: 471-9
- Cheke, A.S. 1984.
Lizards of the Seychelles. in *Biogeography and ecology of the Seychelles islands* (Stoddart D.R. ed.), Junk, The Hague.
- Frazier, J. 1984.
Marine turtles in the Seychelles and adjacent territories. in *Biogeography and ecology of the Seychelles islands* (Stoddart D.R. ed.), Junk, The Hague.
- Friedmann, F. 1987.
Flowers and Trees of Seychelles. ORSTOM, Paris.
- Gerlach, J. 1993.
Invasive Melastomaceae in Seychelles. *Oryx* 27(1):22-26
- Greig-Smith, P.W. 1986.
The distribution of native and introduced landbirds on Silhouette Island, Seychelles. *Bio. Cons.* 38: 35-54.
- Matyot, P. 1990a.
Carausius scotti rediscovered. *Phasmid Study Group Newsletter* 44; 6-7.
- 1990b
Observations on *Carausius scotti*. *Phasmid Study Group Newsletter* 45; 7
- Mortimer, J.A. 1984.
Marine Turtles in the Republic of the Seychelles. IUCN, Gland.
- Nicoll, M. & Suttie, J. 1982.
The sheath-tailed bat in the Seychelles islands. *J. Zool.* 197: 421-426.
- Nussbaum, R.A. 1984.
Amphibians of the Seychelles. in *Biogeography and ecology of the Seychelles islands* (Stoddart D.R. ed.), Junk, The Hague.
- Oxford University Silhouette Expedition 1990.
Final Report.
- Scott, H. 1910.
Eight months entomological collecting in the Seychelles Islands. *Trans. Linn. Soc., Lond. (Zool)*. 14: 24-39.